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MOUNTAIN AREAS — TRANSLATION — 1931

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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

REFORESTATION AND WALL WORKS IN THE RESTORATION  
OF MOUNTAIN BASINS

G. Di Tella

From

A'alpe

Rivista Forestale Italiana

1931





FLOOD CONTROL SURVEYS  
GLENDOORA - CALIFORNIA

RS  
Translations

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U. S. DEPARTMENT OF AGRICULTURE  
Forest Service

Rimboschimenti ed Opere Murrarie Nella  
Restaurazione Dei Bacini Montani

(Reforestation and wall works in the  
restoration of mountain basins)

By G. Di Tella

from

A' alpe

Rivista Forestale Italiana

Vol. 18, pp. 241-249

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G. Di Tella, Rimboschimenti ed opere murarie nella restaurazione dei bacini montani, 'Reforestation and wall works in the restoration of mountain basins.' L'Alpe, Rivista Forestale Italiana, 18, pp. 241-259, 1931.

### Memento

#### I

The hydraulic-forestal restoration of mountain watersheds has in recent years assumed an ever increasing importance, and is now assuming a still greater one as a result of the application of the Integral Soil Improvement Law.

Beginning with the special laws of Sardinia, passed in 1889, and of Calabria and the Basilicata, the number of high mountain streams on which regulation has been considered necessary for land improvement is very large. As a result, we have many important regulated streams on which the works have been in effect for the last 25 years and more. These afford now the opportunity of observing and of estimating the results.

The author of these notes has had an opportunity to visit in recent years various projects from Venetia down to Calabria. The impression he obtained has nearly everywhere been that of a general disproportion, rather evident in such cases, between the engineering work and the real forestation work, with the result that the outlay for the former was too high and in the latter too low. The high cost of certain engineering projects is staggering if the indirect and direct benefits really attained are borne in mind. They are the more so because they have not been co-ordinated with forest work and especially with forestation activities, nor (in other regions) with proper irrigation works. As a result, they are extremely precarious.

The fundamental rule of all watershed control projects is that the forestation work should precede or at least accompany the regulation of stream channels, wherever the streams are active, following rains, even if the soil does not always show visible evidence of erosion or the soil and rocks do not appear to need special supporting works.

This rule does not admit exceptions. It is true that in particular emergency cases, it might be advisable to begin such regulatory projects, but to carry out such projects prior to the forestation work and, still worse, to reduce the latter to an experimental basis is a serious error which may well cost the State many millions, expended if not altogether uselessly, certainly far from economically. We do not deny however, that stream regulation is of great importance in the ensemble of the greatest national interests.



Many practitioners, specialists in this field, have noticed this dangerous and costly reversal of elementary principles that must form the base of all such projects in mountain regions. It is therefore urgent to return to these principles and not only to re-establish the original technical and economic order, but to re-examine also the experience gained in a large number of places. So sure has been the thought of those who have violated these principles, one that it has been translated into a series of ordinances, and the technic and the administrative rules have remained unchanged, or nearly so, since 1893, despite the more recent forestry evidence of their defects, which defects are becoming more serious from year to year.

The fact is that the stream-control principles now adopted and followed today in Italy are badly in need of revision. This is not a conclusion arrived at by foresters only in recent years.

As early as 1914, in this same paper, L'Alpe, I called the attention of its readers to this situation. At that time, the solution of the problem was anything but peaceful from the technical view-point, but it came to assume much greater importance from a financial point of view when the expense of all stream control in mountain regions was assumed by the State. At this time I tried to put our technicians on their guard against the tendency then clearly showing itself of going too far in these projects and of stopping the forestry work because of technical forestry difficulties. There was needed an integration of work or, bettersaid, to an 'integral' physical-economic restoration of all the localities when such work was needed.

Nonetheless, this deviation from the fundamentals was continued, although these fundamentals had been clearly indicated by the apostles of the forest and stream-flow idea, from our own Viviani, the first among the first, to the Frenchman Surell. Surell's ideas were largely put into effect by Demontzey between 1870 and 1890 in the French Alps, with the results the latter recognised later on, as not always satisfactory or as not adequate to the serious effort made to carry them out. This he points out in his technical work: Les retenues d'eau et le reboisement dans le bassin de la Durance, a work less known, however, than his classic treatise on Reboisement et gazonnement des montagnes. He left in print, with a scientific honesty which greatly increases his fame as the great master in afforestation, these memorable words:

"Forests, the creation of which is necessary in many mountain watersheds, combined with the forests already in existence, will form water storage reservoirs most safe, most complete, and least costly. They constitute a vast sponge absorbing the rain water and restoring it gradually to the streams. The creation of these living bridles upon water flow can be carried out almost as quickly as the construction of dead bridles which require costly upkeep and would, moreover, hold over the valleys a real sword of Damocles: the forests become the more useful the older they are."



In spite of this clear admonition of Demontzey, some ten years passed before scientific authorities spoke against the growing abuse of engineering projects, authorities such as Kilian, an Austrian geologist, some of our own geologists, and even some of the best forest technicians in France itself: Briot, Fabre, and others.

Let me allude against what I wrote in 1914. After sixteen years I find nothing requiring a modification of my views or a suppression of even a single word of what I then wrote. I must add to them, however, certain statements because of the impressions I received upon recent visits to projects where certain errors in technique developed from a number of circumstances, have now grown enormous proportions. In the beginning of applying a law of such vast technic and financial consequence as that of 'integral soil improvement', it is imperative for the technicians, both foresters and engineers, to prepare themselves for a complete and radical revision of the methods which, in spite of anything but encouraging results, are still being followed systematically and, in certain projects, are even being extended, giving the impression of a technical dilettantism devoid of a just sense of economic proportions between the means and the end. To mention just one point, how can one fail to consider that the alpine streams of Surell and Demontzey are one thing and those of our Appennine region are another, especially in the Lucania and Calabria drainages, where at least for 75% of the area the problem, far from being water-forest-pasture, as in the Alps, is essentially water-agriculture-forest?

I wrote in 1914: "The supreme importance attributed to check dams", the constant reduction in forestation, the costly projects having for their object the fixation of the soil in all of which there is a tendency to exaggerate the harm done or threatened, have resulted in the gradual disappearance of a proper balance between the means and the end. Such a balance especially in this type of undertaking, should always be kept in mind and must always be closely watched to prevent dependence upon deceitful promises of the control by dams, by terracing by the stone beds - in a word by 'palisading' the river with engineering structures - and to prevent becoming too dependent upon such works in the face of the live and progressive forces of erosion which have been greatly increased in strength by the disappearance of the forest cover. The torrent is nothing but the resultant of the disruption of essentially biological factors.

These processes can be reversed in our climate and even in localities with rapid erosion by the establishment of natural vegetation with its complex and always varying associations, from the invisible bacteria which help build up the humus to the mature tree, and growing and renewing itself in a perpetual and progressive vital rhythm. The torrent is, therefore, not merely a cut in the soil, strictly localised, as might be a cut in the human body by a steel weapon; it is rather a morbid affection which can be traced by the eroded paths dug by the rain water, all through the basin, from the summit of the ridge down to the foot, becoming visible only when the ulcer explodes in the most destructive manifestations. To cure this ulcer it is not sufficient to sew up the wound with every septic means; it is rather necessary to follow the wound to its most intimate and



hidden causes, to combat the microbes which are responsible for the destructive force of the torrents, erosion furrows imbedded in the microscopic and against which there is no other certain remedy except that of vegetation. Vegetation alone is capable of giving back to the dying soil its vital activity and to re-establish there its original static equilibrium. Only when attacked in this manner can the torrent be conquered. Attacked in its most pronounced manifestation, it surrenders only temporarily, and then only to keep itself in a deceitful quiet but always ready to awaken more dangerous than ever.

"The check dams, the paved stream-bed, the reinforced banks, etc., may be of use during the cure and, in certain circumstances may be indispensable helps in giving a good start to and hastening the work of revegetation; but because they are so costly, one must make of them only an extremely moderate use and consider them only as exceptional means, not as regular ones. This is, by the way, the very recommendation made by Surell:

"The check dams or barriers are the most efficacious means of defense when it is a question of protecting a limited stretch of the river, and, as a matter of fact, they have heretofore received no other application. If, however, they are carried to the upper parts of the torrent, the same can not possibly be said. Here the velocity increases so rapidly that the walls and dams become insufficient unless they are constructed closely together, or rather piled up one upon the other, as it were.

"Now this would not only be extremely expensive; but the dams would be thus so close to one another that they would in part fail of their goal, because the torrent, proceeding from brink to brink, would not have sufficient time to slow up the speed which it has acquired. The effect of these dams would, in fact, amount to nothing more than to raise the bed of the stream to the degree equal to their height. It is easy to see that this result does not give the goal sought. To reduce this defect as much as possible, it would also be necessary to make the side walls very much higher above the stream bed; but, in that case, the cataracts would become formidable and the holes they produce in the stream bed would be ruinous. The use of such a system of barriers might become outright dangerous in case of a break, and, in a flood, a true disaster.

"All these objections are serious and should induce us to renounce the dams as an efficient remedy capable of being given a general application unless with other methods.

"For this reason Surell recommends their use on condition that they be constructed low and with hurdles and fascines:

"Whereas in the end, plantations bind the soil, the banks can be held by those walls of which I have spoken. The best materials for their composition, however, will be found in most cases in the planted forest itself. The young plants would furnish the stakes while the brushy tops could be used in forming the fascines or bundles of twigs. There would thus be constructed the dams and fascines or bundles so ardently recommended by Fabre." These projects require little labor; the materials would cost almost nothing; they would, therefore, be economical and would present



<sup>1</sup> Cf. Fabre, Essai sur la theorie des torrents et des rivieres, 1797. This was the first work giving a scientific treatment of the torrent problem. The incontestable merit of this book that we find there, in embryo, the system of fighting the 'rodents of the mountains', which was to give so much renown to Surell. Here is what Fabre thought of the dams: "This means is very successful in all rising torrents, that is in those which have not yet hollowed their bed excessively. Experience guarantees their success. But this is not the case when the streams have already become strongly developed and dug deep furrows. In this case their outright extinction must be regarded as impossible." Op. cit., n. 307.

none of the dangers which usually are connected with masonry. They can therefore be multiplied everywhere without inconvenience and almost without cost.

"The causes which in France induced Demontzey, Costa de Bastelica and their pupils to depart from the system of procedure indicated by Surell so clearly as the only probably successful method were two in number:

"The first depended upon the open hostility suddenly shown by the French mountaineers against the afforestation projects begun in application of the first law, that of July 28, 1860. This hostility was not at all diminished by the modification of the law of July 8, 1864. In the face of these unforeseen difficulties, the technicians, trusting in the temporary effects obtained by an increase in the size and the frequency of the checks, labored under the illusion that they could attain stream regulation by multiplying the number and increasing the size of the works, reducing forest plantings to a minimum because objectionable to the mountaineers.

"The second cause must be sought in the explainable inexperience which people had at that time as to the erosive power of the streams, of the character and the impetus of their floods, and of the complex difficulties to be overcome in the application of the system. These causes explain and even justify this period of experimentation during which the errors may often have been necessary to indicate more clearly the course to pursue.

"But they are no longer justified today, since our experience has shown us more and more that the unregulated stream, considered as a phenomenon of geological actuality, is almost everywhere the resultant of a physiological degradation of the soil. This degradation of the soil is a complicated matter, and is accelerated by its further degradation under the action of the elements which merely accelerates the process, not creates it. As a matter of fact, water, even in the smallest furrows and in the smallest rivulets, corrodes the soil wherever vegetation can no longer exert its natural capacity to defend the soil against the weather. Only by a gradual restoration of the vegetable cover can the action of the water be changed and turned into a meek factor serving vital activities.



"The problem does not admit of any other solution. It may be necessary (and this will resolve itself into the proper ratio between the expense and the usefulness of the result) to hasten the work in certain cases by means of auxiliary enterprises; but one should never permit engineering works to prevail over forest planting.

Thus understood, stream regulation can not be considered a project capable of a rapid realization such as the construction of a bridge, a railway, an aquaduct, a house, but rather as a slow and patient reorganization of natural forces, naturally predisposed to cooperate in meeting the objections of stream regulation.

"There is needed a biological approach using living plants, rather than purely mechanical, inert masonry dams. Vegetation alone can succeed in taming wild water and in forcing it partly to flow gently over the surface without corroding it and partly to trickle, drop by drop, into the underground reservoirs which feed the springs!"

## II

Our forest congresses of the last decade have clarified and developed not only technical, but also social and economic ones principles of the type outlined by the forest congress of Bologna, in 1910, regarding the problem in which successful control of streams is a corollary and not a premise.

The technique involved in regulating stream flow in Italy is however described in few books. The only university chair in the subject is that in the Istituto Superiore Agrario e Forestale of Florence.

In our institutes of technology, even in the most important of them, the control of stream flow is not taught in hydraulic engineering, despite the brilliant professors. It is not given the importance it should have because of the lack of emphasis placed upon this special branch and because of the emphasis placed upon geology, on physical geography, on botanical geography and on rural economics.

Streamflow must be considered today, not as a phenomenon standing all by itself, but in the larger frame of physical and economical environment which is complex and varied in the various localities.

It is a question of a co-ordinated attack in which physical geography, physics, biology, and economics combined which can not be reduced to one static factor alone. The torrent, say the geographers Penck and his successors, like all water courses, is an instrument in reducing the terrestrial relief to more level forms. The evolution of the mountain into the plain follows a universal law, from the application of which land is exempt. Against the application of this law the forests intervene as climatic expressions of a natural biological reaction in which the earth has a tendency to oppose this levelling and succeeding thus in slowing down, if not in stopping altogether, the formation of this level plain.



Thus, there arises from the eternal interplay of all these opposing forces, the harmony which man destroys by his various forms of deforestation.

Human regulation of any water course, river or torrent, can therefore have no other goal than a relative stability, not an absolute one. It may bring about a slowing down but not a cessation of the phenomena which are essentially of a geological nature.

If hydraulic engineering is thus placed in this wider and more concise physio-geographical frame, what a flood of new light immediately is shed upon man's various urgent and contingent works against the levelling force of the waters,

Should we perhaps persist in the old continuous struggle without hope of final success and lasting victories, by means of the ingenious arts of defense, and should we renounce a strategy which is seemingly more efficient?

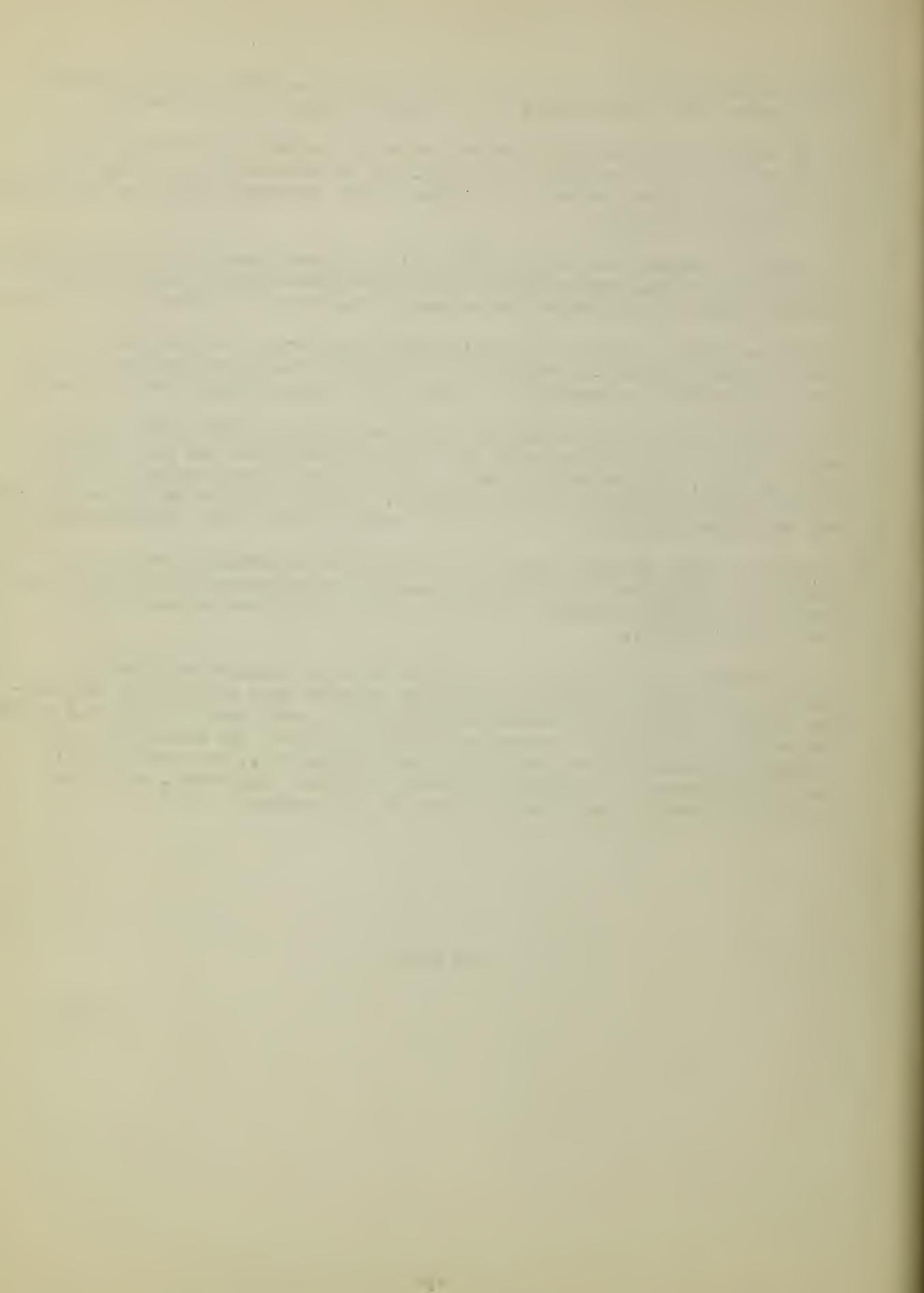
No, we must not give up completely this strategy, especially when the difficulties are more easily overcome both from the technical and the financial point of view; but we should always give time its highest value, for this is the essential factor of the reconquest, in correcting the disturbed physical and economical equilibria of our rough lands suffering from overpopulation.

In the low-lying alluvial plains, we must in the meanwhile, provide the streams with embankments and levels, and with other defensive measures which would be altogether avoided if we had properly regulated streams in the mountains and hills.

It is certain, however, that we would be taken by surprise when failure greets our efforts to control streams by reliance upon a system of engineering works instead of the natural plant defenses, even though these dead works are arranged according to ingenious (I have no doubt) but uncertain calculations of limited curves, of poised declivities, etc., and above all of the illusory abuse of passive resistance to a live, impetuous, and at the same time convulsive and powerful force of the torrents.

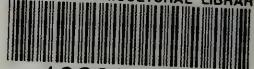
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